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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/584,739	06/01/2000	Kuniko Kikuta	PF-2622/NEC/US/mh	3028

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EXAMINER

QUACH, TUAN N

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 06/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n No.

09/584,739

Applicant(s)

KIKUTA, KUNIKO

Examiner

Tuan Quach

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 March 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4,6-12,15-25,28-37 and 57-64 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4,6-12,15-25,28-37 and 57-64 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 14.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

The amendment filed March 4, 2003 has been received. Claims 3, 5, 13, 14, 26, and 27 are cancelled. Claims 1, 12, 22, 57-61 are amended. New claim 64 is added. Claims 1, 2, 5, 6-12, 15-25, 28-37, and 57-64 are pending.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action. For convenience in referring to the applied prior art, "et al" is omitted.

Claims 1, 2, 4, 6-12, 15-25, 28-37, 57-64 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

"As P" in these claims, e.g., claim 1 line 2 is erroneous; claims 15, 17-18, 28, 29, depend from a cancelled claim.

Claims 4, 7-9, 16-19, 23-25, 28, 29 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. The limitation in these claims already was recited in the claim they ultimately depend from.

Claims 1, 2, 4, 6-12, 15-25, 28-37, 57-64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Edelstein or Dubin taken with any of Kato, Oyama, Yamasaki, and further in view of Tsuji.

Edelstein teaches copper alloys, e.g., column 6 line 10 to column 8 line 50 wherein copper alloys including various materials, e.g., B, P, Ni, Ag, and various metals, such as Mo, W, Si, Ge, Ta, to obtain improved electromigration resistance. Alloys such as Cu(Ti) are also delineated. See column 8 lines 29 to column 9 line 3 wherein the inclusion of material such Ag and of Mo, W, is also delineated. Application of such materials on the via hole in semiconductor devices including underlying barrier is also shown.

Dubin teaches the use of copper alloys including in via contact holes, e.g., trench 12, including barrier 52, e.g., column 7 lines 7-21, including alloy layers 56, 57, the alloys being suitable Cu alloys including alloys of Cu with any of various metals, wherein the alloys can also include various alloying elements, e.g., Ni, Ag, etc. See column 5 line 30 to column 6 line 50.

Tsuji teaches the inclusion of various elements including P, Ni, Ag, B, As, Si, Cr and appropriate amounts, e.g., see the abstract column 4 lines 26-69, Tables 1 and 2, column 6 lines 65-66, to obtain alloys having excellent conductivity and heat resistance. The selection of appropriate amounts is also shown, e.g., column 4 lines 37-58 wherein such optimization, e.g., regarding conductivity is also shown.

Kato (63-262437) teaches copper alloy having high electroconductivity including Sb, e.g., 0.5%. See the abstract.

Oyama (3-285,035) teaches copper alloys having excellent migration resistance including Ti of 0.1 to 1.0%. The inclusion of Ni of appropriate amount, including

between 0.3 and 2.5 % for the improved electrical conductivity as well as the improved migration resistance. See the abstract.

Yamazaki also teaches copper alloy having excellent heat and electrical conductivity wherein appropriate amount of metal such as Ti, e.g., 0.05 to 1% is optimized. See the abstract, column 2 lines 23-25.

It would have been obvious to one skilled in the art in practicing Dubin and Edelstein to have employed suitable copper alloys including the various elements claimed to suitable amounts since such alloys are conventional and advantageous where appropriate amounts would result in improved copper alloys as evidenced by Kato, Oyama, Yamazaki, and Tsuji. The selection and optimization of appropriate amounts would have been further obvious given the teachings of appropriate amounts as shown in Kato, Oyama, and Yamazaki where the amounts anticipating or rendering obvious the amounts claimed, and further would have been obvious, and as delineated in Tsuji wherein decrease in conductivity can be prevented. The copper alloys having lower melting point would have been obvious and inherent given that the appropriate amount of alloying materials is employed.

Applicant's arguments filed March 4, 2003 have been fully considered but they are not persuasive.

Applicant argues that Tshuji, Kato, Oyama, and Yamasaki teach away from the combination of the references because they do not suggest a copper interconnection structure with improved electromigration resistance, adhesion and surface properties and thus teach away from the combination of the references.

This however overlooks the teachings of Edelstein regarding the copper alloys including material such Edelstein teaches copper alloys, e.g., column 6 line 10 to column 8 line 50 wherein copper alloys including various materials, e.g., B, P, Ni, Ag, and various metals, such as Mo, W, Si, Ge, Ta, to obtain improved electromigration resistance, corresponding to the characteristics sought by applicant, see e.g., page 13 line 18 of the specification. Edelstein and Dubin as delineated above also clearly establish the use of copper interconnection and metallization including the conventional application in openings for metallization. This also overlooks the fact that the claims are not limited to a copper interconnection and further are not limited to any specific or any specified electromigration resistance, adhesion and surface properties and encompass an electrically conductive layer. See, e.g., claim 1 line 1. Accordingly, contrary to applicant's argument, the claimed invention is not limited to trench groove with narrow width and nowhere recites or is limited to the suppression of growth of copper crystal grain of small size. It remains apparent that the increased conductivity in such claimed electrically conductive layer would have been pertinent and provides appropriate motivation for combination. Furthermore, the references above nowhere teach that the combination is not permitted and in fact provide further motivation for inclusion, including the characteristics that are desirable for electrically conductive layer and also provide applications in semiconductor devices and components. Kato and Tsuji, for instance, however nowhere teaches that the reference cannot be combined and further evidences regarding the advantages of high conductivity and further teach the limitation regarding the composition of added alloying materials for the desired conductivity. The

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argument further fails to take into consideration the teachings of Oyama wherein the improved electromigration resistance, good electrical conductivity and strength are realized, including the addition of appropriate alloying amounts is taught are realized, thus clearly evidences that the objectives are not necessarily mutually exclusive.

The IDS submitted has been considered and also does not appear to provide any evidence of non-obviousness; the Japanese Office action cited therein also held the instant invention to have been obvious.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number is 703-308-1096. The examiner can normally be reached on M - F from 9 to 5.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (703) 308-4918. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9318 (Before Final) and (703) 872-9319 (After Final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Tuan Quach
Primary Examiner